

# RECLAMATION

*Managing Water in the West*

## **Avian Post Development Monitoring at the Cibola Nature Trail Restoration Site - Breeding Season 2005**



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**Bureau of Reclamation Lower Colorado Region  
Multi-Species Conservation Program**



**U.S. Department of the Interior  
Bureau of Reclamation  
Lower Colorado Regional Office  
Boulder City, NV 89006**

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## Abstract

The Cibola Nature Trail Restoration Site is a demonstration project that was established in 1999 as a joint effort between the Bureau of Reclamation and the Cibola National Wildlife Refuge to create specific habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*). Reclamation has conducted avian post development monitoring each breeding season since 2002 at the Cibola Nature Trail Restoration Site using three methods: avian area searches, constant effort mist netting using the Monitoring Avian Productivity and Survivorship (MAPS) protocol and tape playback surveys for the southwestern willow flycatcher (Sogge *et al.* 1997). The most abundant species detected in 2005 were the red-winged blackbird, house finch, brown-headed cowbird, great-tailed grackle, western kingbird, Lucy's warbler, ash-throated flycatcher, mourning dove and Bullock's oriole. A small population of yellow warblers and one Bell's vireo were the only lower Colorado River Multi-Species Conservation Plan (LCR MSCP) covered species present at the site; however, 11 avian species listed in the LCR MSCP as sensitive, non-covered species were present. Habitat generalists have comprised the majority of the avian population since avian monitoring began in 2002. Reclamation has gained valuable information from avian post development monitoring at this site. Small patch sizes appear to attract habitat generalists and mature mesquite trees provide suitable habitat for the Lucy's warbler.

## Introduction

The lower Colorado River (LCR) travels from Lees Ferry, south of Glen Canyon Dam to the Gulf of California in Mexico. Flowing through the Mohave and Sonoran deserts, the LCR provides a large expanse of riparian vegetation in an arid environment (American Bird Conservancy 2003). Over 90% of riparian habitat has been lost to river channelization, agricultural land conversion, habitat destruction, urban development, mining, overgrazing, and invasion of salt cedar (*Tamarix sp.*) (Rosenberg *et al.* 1991, Powell and Stiedl 2000).

The Cibola Nature Trail Restoration Site is a demonstration restoration project that was established in 1999 as a requirement of Reasonable and Prudent Alternative (RPA) 14 in the 1997 Biological and Conference Opinion on Routine Operations and Maintenance of the lower Colorado River. RPA 14 requires Reclamation to establish demonstration projects to study ecological restoration techniques along the LCR (USFWS 1997). The Cibola Nature Trail Restoration Site was a cooperative effort between Reclamation and the Cibola National Wildlife Refuge (CNWR) to create specific habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*) (Raulston 2003). Post development monitoring of this site provides ecological data to be utilized in the adaptive management process of the Lower Colorado River Multi-Species Conservation Plan (LCR MSCP).



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The LCR MSCP, signed on April 4, 2005, is a 50 year cooperative Federal-Lower Basin States-Tribal-Private effort to provide conservation measures for 26 covered species while providing regulatory relief for ongoing and future river management operations (LCR MSCP HCP 2004). Two conservation measures of the LCR MSCP are: 1) creation and maintenance of habitat and 2) adaptive management through monitoring and research. Both conservation measures are expected to benefit LCR MSCP covered and non-covered species (LCR MSCP HCP 2004). One of the four components of the adaptive management process is post development monitoring (LCR MSCP HCP 2004). The purpose of avian post development monitoring is to collect avian abundance, composition, diversity and richness data at each restoration project to analyze effectiveness of created habitats. Reclamation has conducted avian post development monitoring each breeding season since 2002 at the Cibola Nature Trail Restoration Site using three methods: avian area searches (Ralph *et al.* 1993), constant effort mist netting using the Monitoring Avian Productivity and Survivorship (MAPS) protocol (Desante 2002) and tape playback surveys for the southwestern willow flycatcher (Sogge *et al.* 1997).

## Study area

The Cibola National Wildlife Refuge is located along the LCR south of Interstate 10 in Cibola, Arizona. Established in 1964 to offset wildlife and habitat losses due to channelization of the Colorado River, the refuge attracts more than 200 bird species (USFWS 2003). The Cibola Nature Trail Restoration Site located on the refuge was established in 1999 and contains three distinct areas: (1) 5.5 ha mixture of honey (*Prosopis glandulosa*) and screwbean mesquite (*Prosopis pubescens*), (2) 2.6 ha of Goodding willow (*Salix gooddingii*), and (3) 1 ha of Fremont cottonwood (*Populus fremontii*). Exotic Johnson grass (*Sorghum halepense*) invaded as an understory in each of the three areas, and serves as a ground cover reaching up to 2 m in height. The site is an island of habitat surrounded by farm fields on three sides and *Tamarix sp.* on the fourth. In the fall of 2003, *Tamarix sp.* was removed and the area will be planted with native vegetation.

## Methods

The following avian surveys were conducted at the Cibola Nature Trail Restoration Site during the breeding season of 2005: avian area searches (Ralph *et al.* 1993), a constant effort mist netting station operated according to Monitoring Avian Productivity and Survivorship (MAPS) protocol (Desante *et al.* 2003), and tape playback surveys for the southwestern willow flycatcher (Sogge *et al.* 1997). Area searches were conducted with the MAPS station to detect birds not normally captured in the mist nets. For the area searches, a single factor ANOVA test was used to determine significant difference of mean relative abundance of total individual birds and individual birds per species between years. If there was a significant difference of mean relative abundance between years, a tukey multicomparison test was used to determine in which years the means differed. Refer to the reports “*FINAL Report for the Operation of Two Monitoring Avian Production and Survivorship (MAPS) stations on the Lower Colorado River,*



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2005 Breeding Season” and “Results of the 2005 southwestern willow flycatcher (*Empidonax traillii extimus*) surveys on the Pratt Agriculture and Cibola Nature Trail Restoration Sites” (USBR 2005) for more detailed information on the methodology of the avian surveys.

Species richness, diversity and evenness were calculated for the MAPS data and the area search data separately. Species richness was calculated as total number of species present. A species diversity index provides more information about community composition than species richness; it takes the relative abundance of different species into account. Evenness is a measurement of species similarity; it is the equitability with which individuals are distributed among the different species. Species diversity and evenness were determined using a natural logarithm version (Nur *et al.* 1999) of Shannon’s Index (Krebs 1989). The equation using natural logarithms is:

$$H' = \sum_{i=1}^{i=S} (p_i)(\ln p_i), \quad i=1, 2, \dots, S$$

where  $S$  = number of species in the sample, and  $p_i$  is the proportion of all individuals belonging to the  $i$ th species. The transformation of  $H'$  is given by  $e^{H'}$  that is labeled as  $N_1$  (MacArthur 1965).  $N_1$  is used because it expresses diversity in terms of species whereas  $H'$  is expressed in bits. Species distribution is maximally even when  $S = N_1$ . Evenness expressed as  $H'/H_{\max} = H'/\ln S$  is a measurement of how similar the abundance of different species are. Evenness is equal to 1.0 when there are similar proportions of all species. Community similarity between the three phases was measured with the Renkonen index (Percentage Similarity index):

$$P = \sum \text{minimum } (p_i^A, p_i^B)$$

whereas  $p_i^A$  is the percentage of species  $i$  in sample A and  $p_i^B$  is the percentage of species  $i$  in sample B and  $S$  is the number of species found in either sample (Nur *et al.* 1999).

## Results

### Monitoring Avian Productivity and Survivorship (MAPS) constant effort mist netting station at the Cibola Nature Trail Restoration Site

Twenty-five resident and 14 migrant species were captured during the 2005 breeding season (Figure 1,2). Appendix 1 contains a list of common names, scientific names and American Ornithological Union (AOU) codes of species observed at the site. Capture rate for all captures of all species was .7089 birds per net hour and for individual captures of resident species were .5506 birds per net hour. All captures are defined by any capture including re-captures and unbanded birds. Individual captures are captures of unique individuals where re-captures of the same individual are not counted in the total. Table 1 shows the annual return rates for the breeding season of 2005. Blue grosbeak and Bullock’s oriole exhibited survivorship estimates between 7%-45%, and 7%-32%; respectively. Shannon’s species diversity index was 13.73, species richness was 25, and evenness was .8193 during the breeding season for resident species. For more detailed results of the MAPS station at the Cibola Nature Trail Restoration Site refer to the report “*FINAL report for the operation of two Monitoring Avian Production and*



*Survivorship (MAPS) stations on the lower Colorado River, 2005 Breeding Season” (USBR 2005).*

### **Area Search at the Cibola Nature Trail Restoration Site**

A mean of 137.35 individual resident birds, comprising 34 species, and a mean of 1.89 migrant birds, comprising 5 species, were detected during the 2005 breeding season (Figure 3, 4). Shannon’s species diversity index was 12.48, species richness 34 and evenness was .7147 during the breeding season of 2005 for resident species. The mean relative abundance of common yellowthroats was significantly higher in the 2002 season than the 2003, 2004 and 2005 seasons. The mean relative abundance of Bullock’s orioles was significantly higher in the 2005 season than in the 2002 season. For more detailed results of the area search at the Cibola Nature Trail Restoration Site refer to the report “*FINAL report for the operation of two Monitoring Avian Production and Survivorship (MAPS) stations on the Lower Colorado River, 2005 Breeding Season*” (USBR 2005).

### **Tape play back surveys for the southwestern willow flycatcher at the Cibola Nature Trail Restoration Site**

Fourteen willow flycatchers were detected in the first five surveys during southwestern willow flycatcher surveys. No willow flycatchers were detected after June 18<sup>th</sup>. For more detailed results of southwestern willow flycatcher surveys refer to the report “*Results of the 2005 southwestern willow flycatcher (Empidonax traillii extimus) surveys on the Pratt Agricultural and Cibola Nature Trail Restoration Sites*” (USBR 2005).

## **Discussion**

The Cibola Nature Trail Restoration Site encompasses two land cover types (cottonwood-willow and honey mesquite III) that Reclamation plans to restore to fulfill requirements of the LCR-MSCP. The only LCR-MSCP covered avian species detected at the site were Sonoran yellow warblers, in small numbers, and one Arizona Bell’s vireo. Eleven species listed in the LCR-MSCP as sensitive non-covered riparian species were present at the site. Abert’s towhees and Lucy’s warblers, which were present through out the breeding season, are listed as species of concern in the Partners in Flight North American Landbird Conservation Plan (Rich *et al.* 2004). There is no standard scale for species diversity, evenness or richness for the values at the Cibola Nature Trail Restoration Site to determine if these values would be considered low, medium, or high. However; we can compare diversity, evenness and richness numbers to other restored and non restored sites along the LCR. Refer to the report “*Avian post development monitoring of restoration sites along the Lower Colorado River, breeding season of 2005*” for comparisons between sites.





The Cibola Nature Trail Restoration Site was created to provide habitat specifically for the southwestern willow flycatcher (Raulston 2003). For a willow flycatcher to be considered a southwestern willow flycatcher it must be present after June 21<sup>st</sup> (Sogge *et al.* 1997). Several willow flycatchers utilized the habitat during migration but no southwestern willow flycatchers were present at this site after June 21<sup>st</sup>. Several sensitive non-covered riparian species were present at this site but in small numbers. Approximately 70% of avian species present at this site were comprised of habitat generalists (red-winged blackbirds, mourning doves, brown-headed cowbirds, house finches, western kingbirds and great-tailed grackles). Possible reasons for the absence of southwestern willow flycatchers, as well as other LCR MSCP covered species, are the absence of constant water or moist soils, lack of dense understory, lack of mature trees and the small patch size of the habitat surrounded by agricultural fields.

Changes in species composition and abundance were minimal as the Cibola Nature Trail Restoration Site has matured over the past 6 years. The only notable differences in the area search data were the Bullock's orioles increased and common yellowthroats decreased as the site matured. Bullock's orioles breed in riparian and oak woodlands where trees are large (Rising and Williams 1999), and probably increased at the site due to the habitat maturing. The ash-throated flycatcher and Lucy's warbler exhibited a notable increase in population evident in the MAPS data. Lucy's warblers breed in mesquite or willow thickets, especially where trees are large enough to provide adequate nest sites (Johnson *et al.* 1997). The mesquite habitat probably became more suitable for Lucy's warblers as the trees matured. Ash-throated flycatchers breed in riparian woodland where trunks or branches are thick enough to serve as nest cavity substrates (Cardiff *et al.* 2002), and probably increased at the site due to the habitat maturing. Another possible reason for the increase of ash-throated flycatchers, Lucy's warblers and Bullock's oriole was the high amount of precipitation that occurred along the river during the winter and spring of 2004/2005. With more years of data, Reclamation biologists will be able to determine if the increase in population of these species was due to site specific factors or due to other factors such as precipitation.

Constant effort mist netting stations will be operated in select restoration sites through out the length of the LCR MSCP according to MAPS protocol. As other MAPS stations are operated on restoration sites, survivorship, productivity, and condition data from this site could be compared to other restoration sites. Survivorship estimates for this year were not conclusive with large standard errors; this is likely due to the fact that only three years of data is available for analysis. Reclamation biologists expect more conclusive survivorship results with additional years of data. Area searches will be operated with the MAPS station to detect species that are normally not captured in the nets. Comparisons between the two methods are found in the report "*FINAL Report for the Operation of Two Monitoring Avian and Production and Survivorship (MAPS) stations on the Lower Colorado River, 2005 Breeding Season*" (USBR 2005). Area search data and constant effort mist netting data will be analyzed separately for species composition, richness, diversity and evenness. Differences in species richness, species diversity, evenness and species composition existed between the MAPS and area search data. Reclamation biologists expected differences in species composition between the two methods because MAPS does not



detect all species of birds. For further explanation on the difference in results between the two methods see the report “*FINAL Report for the Operation of Two Monitoring Avian and Production and Survivorship (MAPS) stations on the Lower Colorado River, 2005 Breeding Season*” (USBR 2005).

The Cibola Nature Trail Restoration Site was established in 1999. Since avian monitoring was initiated in 2002, species composition has not changed much. Red-winged blackbirds, house finches, mourning doves, Bullock’s orioles, western kingbirds and brown-headed cowbirds have been the major species utilizing the site through out the years. Due to the late stage of development and small patch size of the site, Reclamation biologists do not expect species composition at this site to significantly change unless agricultural fields surrounding the site are converted to habitat. Nevertheless, biologists have gained valuable information from avian monitoring data at the site. Small patch size of habitat appears to attract more habitat generalists than riparian obligate species. Mature mesquite trees provides habitat for breeding Lucy’s warblers. Mature cottonwood trees provide breeding habitat for western kingbirds and Bullock’s orioles. Tree height and DBH are important factors to consider when creating suitable habitat for particular species. The importance of continually monitoring these sites is vital to the implementation of future restoration projects. Avian species are good indicators of ecosystem health due to their sensitivity to environmental change regarding a variety of physical and biological factors (Elliot *et al.* 2004).

## Recommendations

1. Continue conducting area searches with the MAPS station at the Cibola Nature Trail Restoration Site.
2. Consider operating the MAPS station longer than the required 5 years for more conclusive results on productivity and survivorship.
3. Determine an adequate way to measure bird condition and use that method consistently.



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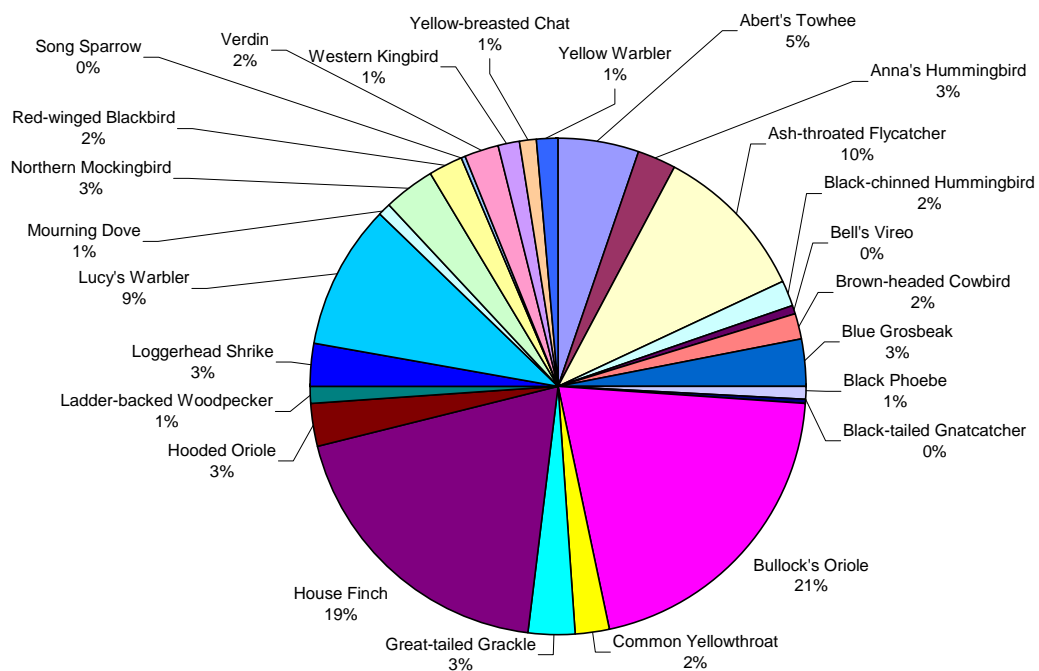
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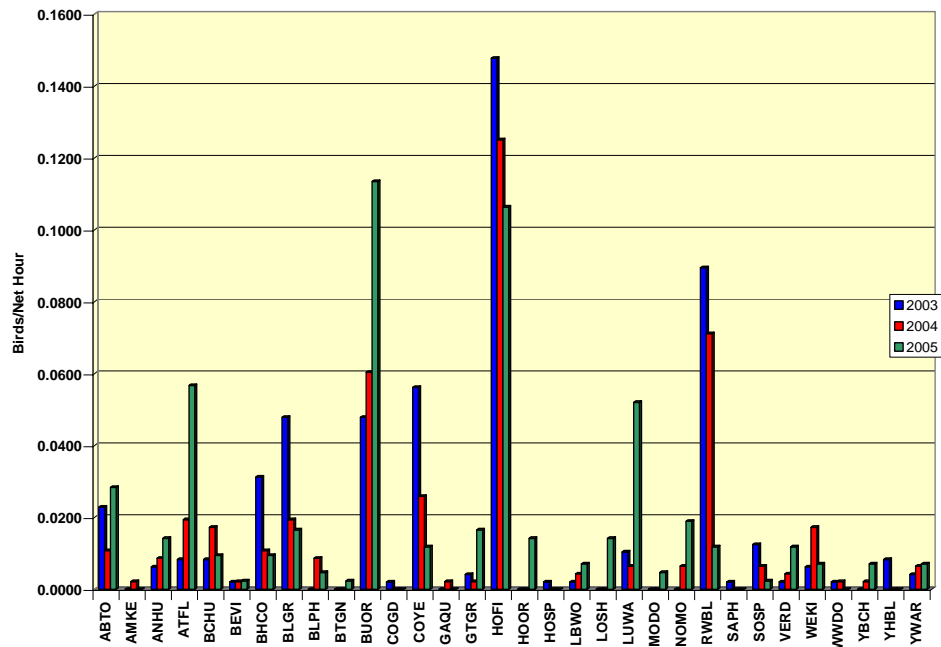
**Table 1: Species that exhibited annual return rate at the Cibola Nature Trail Restoration Site, breeding season 2005.**

| Species              | Annual Returns | Total Individuals | Annual Return Rate |
|----------------------|----------------|-------------------|--------------------|
| Brown-headed cowbird | 1              | 4                 | 25.00%             |
| Blue Grosbeak        | 4              | 7                 | 57.14%             |
| Bullock's Oriole     | 4              | 48                | 8.33%              |
| Total                | 9              | 274               | 3.28%              |

**Figure 1: Resident Species Composition at the Cibola Nature Trail Restoration Site MAPS station, breeding season 2005.**



**Figure 2: Comparison of mean relative abundance of resident species at the Cibola Nature Trail Restoration Site, breeding season 2003-2005**



**Figure 3: Resident Species Composition at the Cibola Nature Trail Restoration Site Area searches breeding season 2005**

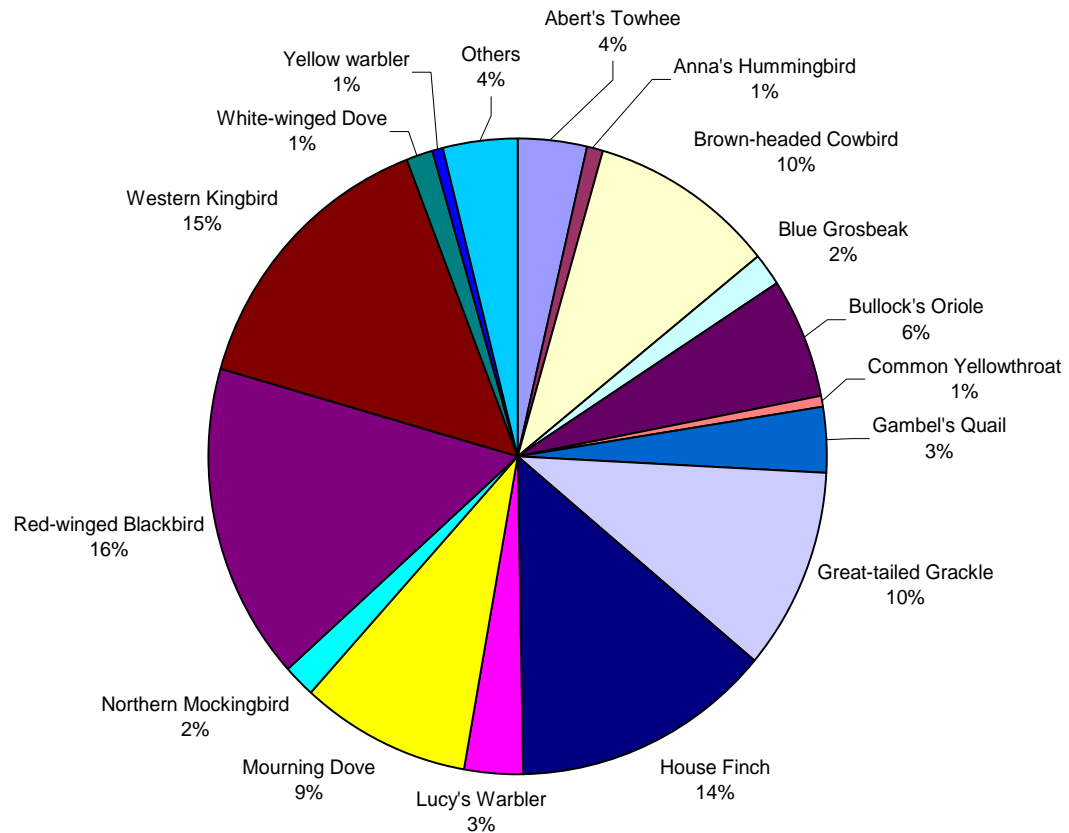
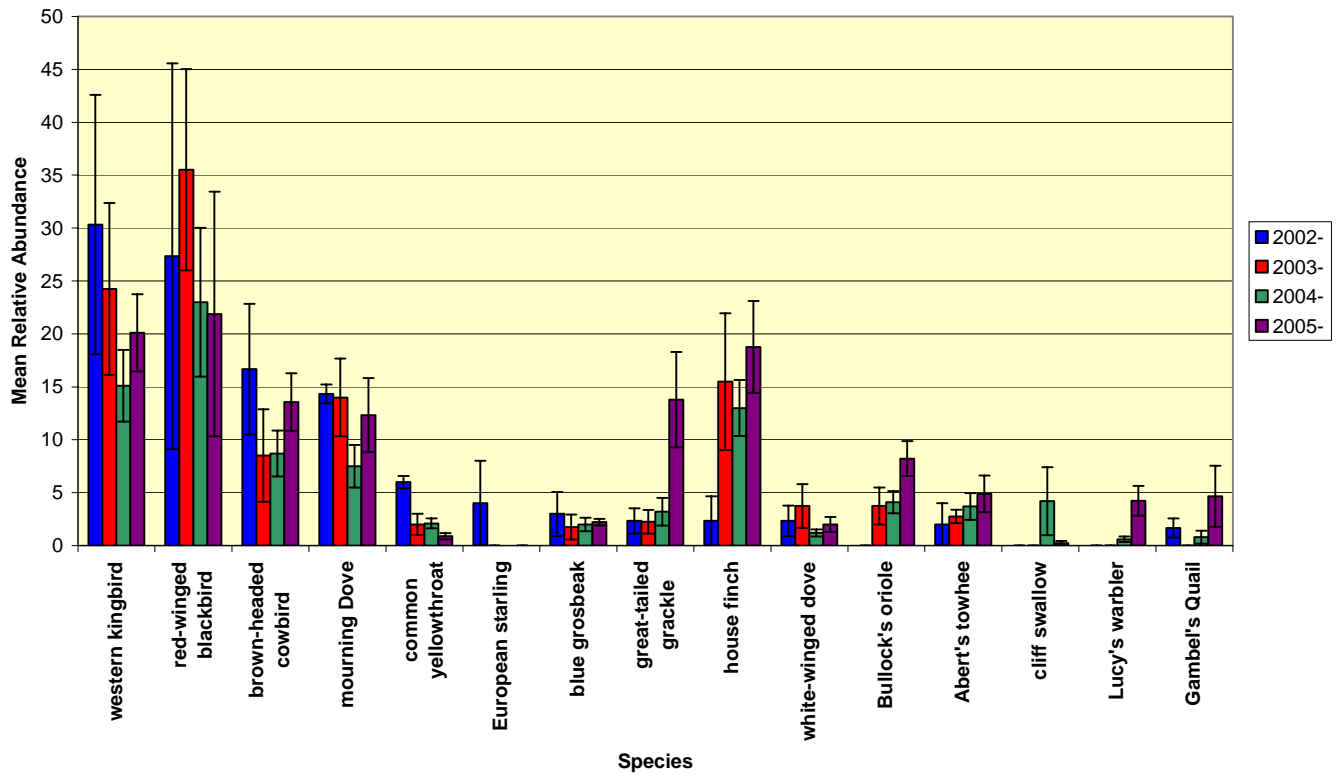


Figure 4: Comparison of mean relative abundance and standard error bars of most abundant species detected at the Cibola Nature Trail Restoration Site, breeding season 2002-2005





**Appendix 1: Scientific name, common name, standard AOU (American Ornithological Union) Codes of species detected at the Cibola Nature Trail Restoration Site.**

| <u>Code</u> | <u>Common Name</u>            | <u>Scientific Name</u>             |
|-------------|-------------------------------|------------------------------------|
| GHOW        | great-horned owl              | Bubo virginianus                   |
| GAQU        | Gambel's quail                | Callipepla gambelii                |
| WWDO        | white-winged dove             | Zenaida asiatica                   |
| MODO        | mourning dove                 | Zenaida macroura                   |
| COGD        | common ground-dove            | Columbina passerine                |
| LENI        | lesser nighthawk              | Chordeiles acutipennis             |
| BCHU        | black-chinned hummingbird     | Archilocus alexandri               |
| ANHU        | Anna's hummingbird            | Calypte anna                       |
| COHU        | Costa's hummingbird           | Calypte costae                     |
| LBBO        | ladder-backed woodpecker      | Picoides scalaris                  |
| WWPE        | western wood pee-wee          | Contopus sordidulus                |
| WIFL        | willow flycatcher             | Empidonax trailii                  |
| WEFL        | western flycatcher            | Empidonax difficilis /occidentalis |
| PSFL        | Pacific-slope flycatcher      | Empidonax difficilis               |
| ATFL        | ash-throated flycatcher       | Myiarchus cinerascens              |
| WEKI        | western kingbird              | Tyrannus verticalis                |
| LOSH        | loggerhead shrike             | Lanius ludovicianus                |
| BEVI        | Bell's vireo                  | Vireo belli                        |
| PLVI        | plumbeous vireo               | Vireo plumbeus                     |
| NRWS        | northern rough-winged swallow | Stelgidopteryx serripennis         |
| CLSW        | cliff swallow                 | Petrochelidon pyrrhonota           |
| VERD        | verdin                        | Auriparus flaviceps                |
| RBNH        | red-breasted nuthatch         | Sitta Canadensis                   |
| BTGN        | black-tailed gnatcatcher      | Polioptila melanura                |
| SWTH        | Swainson's thrush             | Catharus ustulatus                 |
| NOMO        | northern mockingbird          | Mimus polyglottos                  |
| LUWA        | Lucy's warbler                | Vermivora luciae                   |
| YWAR        | yellow warbler                | Dendroica petechia                 |
| MGWA        | Macgillivray's warbler        | Oporornis tolmiei                  |
| COYE        | common yellowthroat           | Geothypis trichas                  |
| WIWA        | Wilson's warbler              | Wilsonia pusilla                   |
| YBCH        | yellow-breasted chat          | Icteria virens                     |
| WETA        | western tanager               | Piranga ludoviciana                |
| ABTO        | Abert's towhee                | Pipilo aberti                      |
| SOSP        | song sparrow                  | Melospiza melodia                  |
| BHGR        | black-headed grosbeak         | Phueciticus melanocephalus         |
| BLGR        | blue grosbeak                 | Guiraca caerulea                   |
| LAZB        | lazuli bunting                | Passerina amoena                   |
| RWBL        | red-winged blackbird          | Agelaius phoeniceus                |
| GTGR        | great-tailed grackle          | Quiscalus mexicanus                |
| BHCO        | brown-headed cowbird          | Molothrus ater                     |
| BUOR        | Bullock's oriole              | Icterus bullockii                  |
| HOFI        | house finch                   | Carpodacus mexicanus               |

